ADAPTIVE MANAGEMENT OF THE COLORADO RIVER ECOSYSTEM BELOW GLEN CANYON DAM, ARIZONA

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Closed in 1963, Glen Canyon Dam has drastically altered natural flood frequency and sediment-transport of the Colorado River through Grand Canyon. In fall 1992, the Grand Canyon Protection Act (GCPA) required that Glen Canyon Dam be operated to benefit downstream resources of the Colorado River ecosystem. The law also required that an environmental impact statement be prepared on dam operations. In March 1995, the *Operations of Glen Canyon Dam – Final Environmental Impact Statement (GCDEIS)* was completed. The GCDEIS proposed a "preferred alternative" for dam operations intended to achieve the intent of the GCPA. This "Modified Low-Fluctuating Flow" alternative became the Secretary of the Interior's Record-of-Decision (ROD) in fall 1996. The GCDEIS also recommended that future operational impacts be monitored through a science-based, adaptive ecosystem assessment approach. To scientifically support the adaptive management approach, the Secretary created the Grand Canyon Monitoring and Research Center (GCMRC) in 1995, and in fall 1997, established the Glen Canyon Dam Adaptive Management Workgroup (AMWG), as a Federal advisory committee.

The role of the GCMRC is to conduct scientific monitoring and research of river ecosystem response to the Secretary's 1996 ROD. Scientific information gathered by the GCMRC is used by the AMWG to make recommendations to the Secretary as to the effectiveness of the ROD in achieving downstream ecosystem restoration and preservation. The AMWG may also make recommendations on how current operations might be altered to best achieve restoration and preservation of resources, including endangered species, Native American cultural sites, and recreational resources.

Current ROD operations at Glen Canyon Dam normally consist of diurnal fluctuating releases from the dam's powerplant within a limited flow range. Such flows are largely intended to reduce erosion of downstream terrestrial and aquatic habitats related to sand bars, and minimize transport of channel-stored sand out of the ecosystem. Under the ROD, the Modified Low-Fluctuating Flow regime can also be accompanied periodically by a controlled flood-flow from Lake Powell, termed a "Beach/Habitat-Building Flow (BHBF)." The purpose of the BHBF is to rebuild sand bars to higher elevations along shorelines, restore aquatic backwater-channel habitats, deposit nutrients, and restore a dynamic component to the river system. Although the dam has restricted about 85 percent of the sand formerly transported from upstream through the ecosystem, periodic inputs from unregulated tributaries provide sand to the main channel for redistribution by the occasional BHBF. A large-scale experimental test of the BHBF in 1996, showed that beaches were rebuilt during the controlled flood, but that aquatic habitats important to the endangered humpback chub (*Gila cypha*) were not restored. Following the 1996 BHBF, the aquatic food base flourished, and there were no signs of negative impacts to native or non-native fish species. Future large-scale flow experiments may also include low-steady flows, and warming of dam releases to benefit endangered native fishes.